PB-240 514

MUD LAKE, ITASCA COUNTY, MINNESOTA

Pacific Northwest Environmental Research Laboratory

Prepared for:

National Environmental Research Center
Minnesota Pollution Control Agency
Minnesota National Guard

January 1975

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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I

REPORT

ON

MUD LAKE

ITASCA COUNTY

MINNESOTA

EPA REGION V

WORKING PAPER No. 115

WITH THE COOPERATION OF THE

MINNESOTA POLLUTION CONTROL AGENCY

AND THE

MINNESOTA NATIONAL GUARD

JANUARY, 1975

II

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Minnesota Pollution Control Agency for professional involvement and to the Minnesota National Guard for conducting the tributary sampling phase of the Survey.

Grant J. Merritt, Director of the Minnesota Pollution Control Agency, John F. McGuire, Chief, and Joel G. Schilling, Biologist, of the Section of Surface and Groundwater, Division of Water Quality, provided invaluable lake documentation and counsel during the course of the Survey; and the staff of the Section of Municipal Works, Division of Water Quality, were most helpful in identifying point sources and soliciting municipal participation in the Survey.

Major General Chester J. Moeglein, the Adjutant General of Minnesota, and Project Officer Major Adrian Beltrand, who directed the volunteer efforts of the Minnesota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

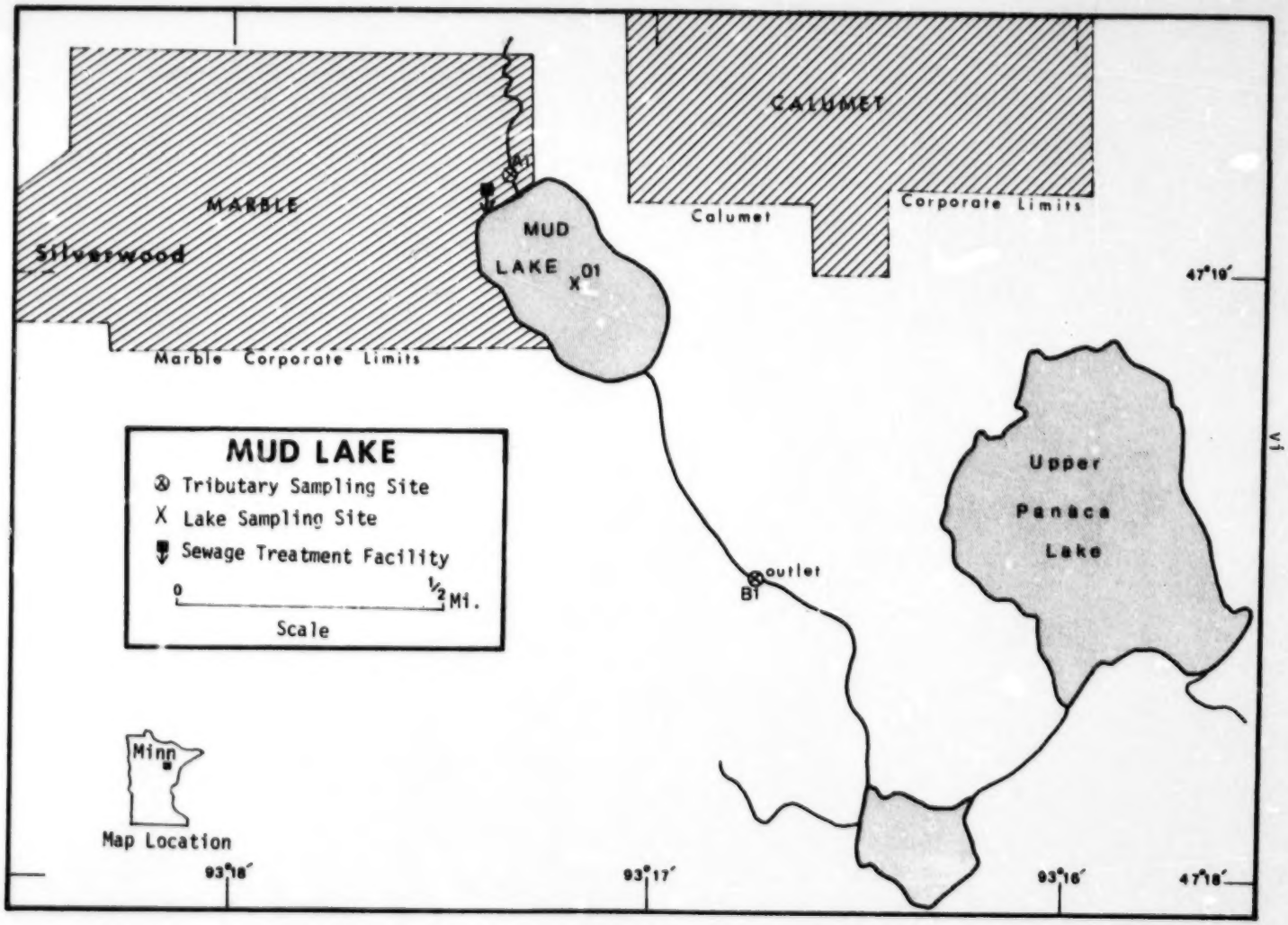
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MINNESOTA

LAKE NAME	COUNTY
Albert Lea	Freeborn
Andrusia	Beltrami
Badger	Polk
Bartlett	Koochiching
Bear	Freeborn
Bemidji	Beltrami
Big	Stearns
Big Stone	Big Stone, MN; Roberts, Grant, SD
Birch	Cass
Blackduck	Beltrami
Blackhoof	Crow Wing
Budd	Martin
Buffalo	Wright
Calhoun	Hennepin
Carlos	Douglas
Carrigan	Wright
Cass	Beltrami, Cass
Clearwater	Wright, Stearns
Cokato	Wright
Cranberry	Crow Wing
Darling	Douglas
Elbow	St. Louis
Embarass	St. Louis
Fall	Lake
Forest	Washington
Green	Kandiyohi
Gull	Cass
Heron	Jackson
Leech	Cass
Le Homme Dieu	Douglas
Lily	Blue Earth
Little	Grant
Lost	St. Louis

LAKE NAME	COUNTY
Madison	Blue Earth
Malmedal	Pope
Mashkenode	St. Louis
McQuade	St. Louis
Minnetonka	Hennepin
Minnewaska	Pope
Mud	Itasca
Nest	Kandiyohi
Pelican	St. Louis
Pepin	Goodhue, Wabasha, MN; Pierce, Pepin, WI
Rabbit	Crow Wing
Sakatah	Le Sueur
Shagawa	St. Louis
Silver	McLeod
Six Mile	St. Louis
Spring	Washington, Dakota
St. Croix	Washington, MN; St. Croix, Pierce, WI
St. Louis Bay	St. Louis, MN; Douglas, WI
Superior Bay	St. Louis, MN; Douglas, WI
Swan	Itasca
Trace	Todd
Trout	Itasca
Wagonga	Kandiyohi
Wallmark	Chisago
White Bear	Washington
Winona	Douglas
Wolf	Beltrami, Hubbard
Woodcock	Kandiyohi
Zumbro	Olmstead, Wabasha


CALUMET
MARBLE
Silverwood
Calumet
Corporate Limits
MUD
LAKE
01
M1
Marble Corporate Limits
47°19′
MUD LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0
½ Mi.
Scale
Upper
Panaca
Lake
outlet
B1
Minn
Map Location
93°18′
93°17′
93°16′
47°18′

MUD LAKE, ITASCA COUNTY

STORET NO. 27C2

I. CONCLUSIONS

A. Trophic Condition:

Survey data show that Mud Lake is eutrophic. Of the 60 Minnesota lakes sampled in the fall of 1972 when essentially all were well-mixed, 12 had greater mean total and dissolved phosphorus, and 11 had greater mean inorganic nitrogen. Of all 80 Minnesota lakes sampled, 7 had greater chlorophyll a values, and all but one had greater Secchi disc transparency.

B. Rate-Limiting Nutrient:

Based on the results of the algal assay, nitrogen was the limiting nutrient at the time the sample was collected. Nitrogen limitation is also indicated by the lake data; i.e., the nitrogen to phosphorus ratios were less than 5/1 on both sampling occasions.

C. Nutrient Controllability:

1. Point sources--The phosphorus load from the Marble wastewater treatment plant was over 98% of the total load reaching Mud Lake during the sampling year.

The present loading rate of 4.96 g $P/m^2/yr$ is over 17 times that proposed by Vollenweider (in press) as "dangerous"; i.e., a eutrophic rate (see page 12). Because of the small

volume of Mud Lake, it is calculated that only complete removal of the phosphorus load from the Marble wastewater treatment plant will achieve an acceptable loading rate (0.06 $g/m^2/yr$).

2. Non-point sources--The mean annual phosphorus load from non-point sources amounted to 1.2% of the total load. The tributary load was estimated to be less than 1% of the total.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 56 acres.
2. Mean depth: 4.3 feet.
3. Maximum depth: 9 feet.
4. Volume: 241 acre-feet.
5. Mean hydraulic retention time: 243 days.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area*	Mean flow*
Unnamed Creek (A-1)	0.6 mi^2	0.2 cfs
Minor tributaries & immediate drainage -	0.5 mi^2	0.3 cfs
Totals	1.1 mi^2	0.5 cfs

2. Outlet -

Unnamed Creek (B-1)**	1.2 mi^2	0.5 cfs

C. Precipitation***:

1. Year of sampling: 22.6 inches.
2. Mean annual: 25.6 inches.

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† Schilling, 1974; mean depth by random-dot method.
* Drainage areas are accurate within ±5%; mean daily flows are accurate within ±10%; and ungaged flows are accurate within ±10 to 25% for drainage areas greater than 10 mi^2.
** Includes area of lake; outflow adjusted to equal the sum of the inflow.
*** See Working Paper No. 1, "Survey Methods".

III. LAKE WATER QUALITY SUMMARY

Mud Lake was sampled twice during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from one station on the lake and from a number of depths (see map, page vi). During each visit, a single depth-integrated (near bottom to surface) sample was composited for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected for chlorophyll a analysis. The maximum depth sampled was 9 feet.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake esentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

FALL VALUES

(10/22/72)

Parameter	Minimum	Mean	Median	Maximum
Temperature (Cent.)	3.5	3.5	3.5	3.5
Dissolved oxygen (mg/l)	8.1	8.1	8.1	8.1
Conductivity (μmhos)	330	330	330	330
pH (units)	8.5	8.5	8.5	8.5
Alkalinity (mg/l)	115	117	117	118
Total P (mg/l)	0.246	0.281	0.281	0.316
Dissolved P (mg/l)	0.169	0.171	0.171	0.173
NO_2 + NO_3 (mg/l)	0.390	0.415	0.415	0.440
Ammonia (mg/l)	0.380	0.400	0.400	0.420
		ALL VALUES		
Secchi disc (inches)	6	9	9	11

B. Biological characteristics:

1. Phytoplankton* -

Sampling Date	Dominant Genera	Number per ml
10/22/72	1. Anabaena	3,072
	2. Flagellates	2,048
	3. Chroococcus	1,386
	4. Microcystis	392
	5. Dinobryon	271
	Other genera	873
	Total	8,042

* The July sample was lost in shipment.

2. Chlorophyll *a* -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
07/12/72	01	34.8
10/22/72	01	139.9

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.160	1.060	30.1
0.005 P	0.165	1.060	31.6
0.010 P	0.170	1.060	29.9
0.020 P	0.080	1.060	30.6
0.050 P	0.210	1.060	34.9
0.050 P + 10.0 N	0.210	11.060	92.6
10.0 N	0.160	11.060	78.4

2. Discussion -

The control yield of the assay alga, *Selenastrum capricornutum*, indicates that the potential primary productivity of Mud Lake was very high at the time the sample was collected. Also the lack of any significant change in yields with increased levels of orthophosphate until nitrogen was also added indicates nitrogen limitation. Note that the addition of only nitrogen resulted in a yield significantly greater than that of the control yield.

Nitrogen limitation is also indicated by the lake data for each of the sampling periods; i.e., the nitrogen to phosphorus ratios were less than 5/1 on both occasions.

IV. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Minnesota National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for the high runoff months of April and May when two samples were collected. Sampling was begun in October, 1972, and was completed in September, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Minnesota District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Stream loadings shown are those measured minus point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the means of the nutrient loads, in $lbs/mi^2/yr$, at station A-1 and multiplying the means by the ZZ area in mi^2.

The operator of the Marble wastewater treatment plant provided monthly effluent samples and corresponding flow data.

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* See Working Paper No. 1.

A. Waste Sources:

1. Known muncipal* -

Name	Pop. Served	Treatment	Mean Flow (mgd)	Receiving Water
Marble	682	act. sludge	0.141	Mud Lake

2. Known industrial - None

* Anonymous, 1974.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Unnamed Creek (A-1)	10	0.4
b. Minor tributaries & immediate drainage (non-point load) -	10	0.4
c. Known municipal STP's -		
Marble	2,450	98.8
d. Septic tanks - Unknown	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	10	0.4
Total	2,480	100.0

2. Outputs -

Lake outlet - Unnamed Creek (B-1) 130

3. Net annual P accumulation - 2,340 pounds

* See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/yr	% of total
a. Tributaries (non-point load) -		
Unnamed Creek (A-1)	500	6.6
b. Minor tributaries & immediate drainage (non-point load) -	420	5.6
c. Known municipal STP's -		
Marble	6,190	81.9
d. Septic tanks - Unknown	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	540	5.9
Total	7,650	100.0

2. Outputs -

Lake outlet - Unnamed Creek (B-1) 1,500

3. Net annual N accumulation - 6,150 pounds

* See Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	lbs $P/mi^2/yr$	lbs $N/mi^2/yr$
Unnamed Creek (A-1)	23	831

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving water would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

	Total Phosphorus		Total Nitrogen	
Units	Total	Accumulated	Total	Accumulated
lbs/acre/yr	44.3	41.8	137.0	110.2
grams/m^2/yr	4.96	4.68	15.4	12.3

Vollenweider loading rates for phosphorus ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Mud Lake:

"Dangerous" (eutrophic rate)	0.28
"Permissible" (oligotrophic rate)	0.14

V. LITERATURE REVIEWED

Anonymous, 1974. Wastewater disposal facilities inventory. MPCA, Minneapolis.

Schilling, Joel, 1974. Personal communication (lake map). MPCA, Minneapolis.

Vollenweider, Richard A., (in press). Input-output models. Schweiz. Z. Hydrol.

VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 27C2 MUD LAKE (ITASCA CO.)

TOTAL DRAINAGE AREA OF LAKE 1.12

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
27C2A1	0.56	0.06	0.02	0.17	0.86	0.58	0.52	0.18	0.06	0.10	0.16	0.08	0.10	0.24
27C2A1	1.12	0.17	0.10	0.29	1.40	1.31	1.03	0.40	0.17	0.25	0.44	0.24	0.27	0.54
27C2Z2	0.56	0.17	0.10	0.20	0.85	0.66	0.52	0.20	0.09	0.14	0.23	0.12	0.20	0.29

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 1.12
SUM OF SUB-DRAINAGE AREAS = 1.12

TOTAL FLOW IN = 6.36
TOTAL FLOW OUT = 6.47

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
27C2A1	10	72	0.07	14	0.05				
	11	72	0.38	19	0.08				
	12	72	0.13	9	0.10				
	1	73	0.12	8	0.10				
	2	73	0.04	14	0.04				
	3	73	0.36	17	0.50				
	4	73	0.26	5	0.30				
	5	73	0.48	5	0.30	20	0.40		
	6	73	0.42	14	0.40				
	7	73	0.16	26	0.18				
	8	73	0.13	20	0.14				
	9	73	0.13						
	10	73	0.13						
27C2A1	10	72	0.20	14	0.20				
	11	72	0.26	19	0.20				
	12	72	0.34	9	0.30				
	1	73	0.31						
	2	73	0.19	18	0.20				
	3	73	0.41	17	0.40				
	4	73	0.54	5	0.60	19	0.50		
	5	73	1.09	5	0.70	20	1.00		
	6	73	0.83	14	0.70				
	7	73	0.35	26	0.40				
	8	73	0.37	20	0.33				
	9	73	0.31						
	10	73	0.31						

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TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 27C2 MUD LAKE (ITASCA CO.)

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
27C227	10	72	0.11	14	0.08				
	11	72	0.13	19	0.10				
	12	72	0.25	9	0.20				
	1	73	0.33						
	2	73	0.19	18	0.20				
	3	73	0.42	17	3.10				
	4	73	0.26	5	0.30	19	0.20		
	5	73	0.55	5	0.30	20	0.50		
	6	73	0.42	14	0.40				
	7	73	0.18	26	0.21				
	8	73	0.18	20	0.19				
	9	73	0.18						

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/10/30

27C201
47 18 58.0 093 17 10.0
MUD LAKE
27 MINNESOTA

11EPALES
3

2111202
0009 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/07/12	19 45	0000			6							
	19 45	0004	23.5	6.0		250	9.00	84	0.160	0.180	0.500	0.330
	19 45	0009	17.4	7.0		300	6.70	132	0.140	3.600	1.710	1.280
72/10/22	15 00	0000			11	330	8.50	118	0.440	0.420	0.316	0.169
	15 00	0006	3.5	4.1		330	8.50	115	0.390	0.380	0.246	0.173

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLOPHYL A UG/L
72/07/12	19 45	0000	34.9J
72/10/22	15 00	0000	139.9J

J VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

Reproduced from best available copy.

STORET RETRIEVAL DATE 74/10/30

27C2A1 LS27C2A1
47 19 00.0 093 17 30.0
UNNAMED TRIB TO MUD LK FROM N
27 7.5 CALUMET
I/MUD LAKE
US 169 XING BETWEEN CALUMETAND MARBLE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	09	50	0.960	0.140	0.085	0.006	0.016
72/11/19	13	35	0.885	0.100K	0.040	0.006	0.160
72/12/09	15	00	0.951	0.100K	0.022	0.005K	0.005K
73/01/06	13	45	1.060	0.240	0.070	0.005K	0.015
73/02/18	10	35	1.020	0.100K	0.013	0.005K	0.010
73/03/17	11	35	0.750	0.440	0.061	0.032	0.040
73/04/05	12	20	0.600	0.340	0.007	0.005K	0.020
73/05/05	13	30	0.340	2.730	0.096	0.009	0.025
73/05/20	14	00	0.770	0.400	0.022	0.008	0.035
73/06/14	12	20	0.560	0.240	0.050	0.005K	0.015
73/07/25	21	20	0.231	0.520	0.088	0.007	0.025
73/08/20	14	12	0.132	0.210	0.032	0.015	0.030
73/10/03	16	07	0.336	0.140	0.024	0.008	0.010

K VALUE KNOWN TO BE LESS THAN INDICATED

20

STORET RETRIEVAL DATE 74/10/30

27C281 LS27C281
47 18 30.0 093 16 30.0
STRM TO SE OUT OF MUD LAKE
27 7.5 CALUMET
0/MUD LAKE
1 MI S CO HWY 12 US 169 JCT
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14			0.400	3.700	0.252	0.098	0.350
72/11/19	14 30		0.510	1.150	0.510	0.025	0.110
72/12/09	13 45		0.820	1.200	0.210	0.015	0.075
73/01/06	14 00		0.960	0.500	0.230	0.028	0.060
73/02/18	10 47		1.000	0.370	0.205	0.023	0.052
73/03/17	14 00		0.680	0.610	0.130	0.050	0.110
73/04/05	10 00		0.010K	1.700	0.022	0.007	0.090
73/04/19	10 05		0.010K	0.695	0.006	0.008	0.095
73/05/05	10 25		0.014	0.500	0.008	0.054	0.065
73/05/20	11 20		0.019	0.860	0.130	0.026	0.110
73/06/14	10 20		0.046	2.300	0.860	0.080	0.195
73/07/26	19 50		0.138	0.810	0.150	0.070	0.130
73/08/20	14 05		0.016	0.750	0.043	0.128	0.290
73/10/03	14 29		0.056	0.690	0.110	0.037	0.080

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

27C251 AS27C251 P000682
47 19 00.0 093 17 30.0
MARBLE
27 7.5 CALUMET
D/MUD LAKE
MUD LAKE
11EPALES 2141284
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/01/25 CP(T)- 73/01/25	11 00 13 00		11.800	1.200	0.110	3.800	3.800	0.115	0.139
73/02/19 CP(T)- 73/02/19	11 00 13 00		10.500	0.700	0.165	4.600	4.900	0.142	0.129
73/03/19 CP(T)- 73/03/19	11 00 13 00		12.800	2.400	0.910	4.800	5.600	0.127	0.144
73/04/16 CP(T)- 73/04/16	11 00 13 00		12.800	0.690	0.290	3.900	4.500		
73/05/21 CP(T)- 73/05/21	11 00 13 00		15.650	0.600	0.240	5.900	6.900		
73/07/19 CP(T)- 73/07/19	11 00 13 00		19.000	0.100K	0.086	7.300	7.500	0.330	0.450
73/08/22 CP(T)- 73/08/22	11 00 13 00		12.100	0.695	0.105	7.700		0.060	0.080
73/09/17 CP(T)- 73/09/17	11 00 13 00		14.000	2.500	0.210	4.520	5.200	0.050	0.055
73/10/15 CP(T)- 73/10/15	11 00 13 00		10.200	1.300	0.026	2.700	3.500	0.127	0.115
73/12/17 CP(T)- 73/12/17	11 00 13 00		12.600	3.700	0.072	4.400	6.400	0.075	0.052
74/01/21 CP(T)- 74/01/21	11 00 13 00		7.400	0.500K	0.040K	2.900	3.200	0.119	0.102
74/02/18 CP(T)- 74/02/18	11 00 13 00		9.300	1.000K	0.040K	3.120	3.700	0.075	0.071

K VALUE KNOWN TO BE LESS THAN INDICATED

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